

REMARKS

The claims have been amended to more appropriately refer to the conductor layer composed of a Group III-V compound semiconductor as being a “conductive boron containing Group III-V compound semiconductor layer.” Claim 1 has been further amended to recite that the stacked structure includes a light-emitting part composed of aluminum gallium indium phosphide, the light-emitting part comprising a light-emitting layer, a lower clad layer and an upper clad layer as described at page 11, lines 11-15 of the specification. Claim 1 has also been amended to recite that the stacked structure further includes a conductive boron containing Group III-V compound semiconductor layer formed on the light-emitting part, and that the light permeable substrate is joined to the stacked substrate through the boron containing Group III-V compound semiconductor layer. This embodiment is shown, for example, by reference to Fig. 2 where the stacked structure 11 includes a light-emitting part composed of aluminum gallium indium phosphide and comprising a light-emitting layer 103, a lower clad layer 102 and an upper clad layer 104, the stacked structure further including a conductive boron containing Group III-V compound semiconductor layer 105 formed on the light-emitting part; and where the light permeable substrate 106 is joined to the stacked structure 11 through the boron containing Group III-V compound semiconductor layer 105.

As claimed in claim 2, the conductive layer has a bandgap at room temperature which is greater than that of the light-emitting layer and not exceeding 5.0 eV. Support is found, for example, at page 15, lines 22-24 of the specification.

As claimed in new claim 12, the conductive layer has a conduction type which is the same as a conduction type of an upper clad layer of the light emitting layer. This embodiment is described at page 14, lines 18-20 of the specification. Namely, in reference to Fig. 2, the

conduction type of the conductive layer 105 is preferably caused to coincide with that of a component layer 104 (i.e., upper clad layer) of the stacked structure which is in contact with the conductive layer 105.

As claimed in new claim 13, an ohmic electrode 107 is formed on the surface opposite the light permeable substrate 106.

New claims 14 and 15 set forth the arrangement order of the various layers constituting the light-emitting device as shown, for example, in Fig. 2.

No new matter is added. Review and reconsideration on the merits are requested.

Claims 1, 2 and 4-6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. 2003/0047737 A1 to Lin et al further in view of U.S. 2003/0141509 A1 to Udagawa (Udagawa '509).

Claims 3 and 7-8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin et al and Udagawa '509, further in view of U.S. 2003/0160253 A1 to Udagawa (Udagawa '253).

Lin et al was cited as disclosing a light-emitting device substantially as claimed, including a stacked structure (Reference Nos. 10, 14, 16, 18, 20, 22, 28, 30-32 and 34, including AlGaInP active layer 20) and a light-permeable substrate 10 joined thereto and supporting the stacked structure. The Examiner relied on Udagawa '509 as disclosing a pn-junction compound semiconductor light-emitting device comprising a stacked structure including conductor layer 103 composed of a Group III-V compound semiconductor containing boron joined to substrate 101. The reason for rejection was that it would have been obvious to modify the device of Lin et al so as to include the conductor layer of Udagawa '509 (composed of a Group III-V compound semiconductor containing boron) joined together with substrate 10 so as to provide a light-

emitting device with improved structure having excellent electrical and omission characteristics, citing paragraph [0002] of Udagawa '509.

Applicants traverse, and respectfully request the Examiner to reconsider in view of the amendment to the claims and the following remarks.

Lin et al does not disclose a device using a Group III-V compound semiconductor layer containing boron, irrespective of whether it is undoped or conductive, as a "transparent adhesive layer 14" for adhering the stacked structure including the light-emitting layer or the light emitting part with the transparent substrate (TS) 10 (refer to paragraphs [0027]-[0029] of Lin et al). In contrast, "the transparent adhesive layer" of Lin et al is made of BCB (bisbenzocyclobutene) or an epoxy (paragraph [0027] of Lin et al), different from the conductive boron containing Group III-V compound semiconductor layer of present claim 1.

Udagawa '509 does not disclose a light emitting diode which includes a transparent substrate. In addition, the light emitting diode of Udagawa '509 uses a Group III-V compound semiconductor layer containing boron (103 and 105) as a cladding layer which is provided adjacent the light emitting layer forming the light emitting part (paragraph [0038]).

Udagawa '253 discloses a device in which a light emitting part employing a boron containing Group III-V compound semiconductor layer is formed on a silicon substrate. However, Udagawa '253 does not disclose a device in which a boron containing Group III-V compound semiconductor layer is used as an adhesive layer for adhering the light emitting part to a transparent substrate.

The boron containing Group III-V compound semiconductor layer of both Udagawa '509 and Udagawa '253 constitutes a light emitting part of a double-hetero structure (for example, in paragraph [0038] of Udagawa '509), where the boron containing Group III-V compound

semiconductor layers are arranged on both sides of the light emitting layer, facing each other, and the boron containing Group III-V compound semiconductor layer is not disposed to join the light emitting layer and the transparent substrate as an adhesive layer.

Accordingly, none of Lin et al, Udagawa '509 and Udagawa '253 discloses or render obvious the use of a boron containing Group III-V compound semiconductor layer as an "adhesive layer" for joining the light emitting part with the transparent substrate. Rather, the prior art references each uses a boron containing Group III-V compound semiconductor layer as a functional layer constituting the light emitting part.

Further, arrangement of the boron containing Group III-V compound semiconductor layer as an adhesive layer with the transparent substrate is not realized, even if the stacked structure, which is comprised of the boron Group III-V compound semiconductor layer as a constituent layer or a buffer layer of the light emitting part, is disposed on the transparent substrate. Namely, if Udagawa '509 is combined with Lin et al, the boron containing Group III-V compound semiconductor layer is part of the light emitting part or the buffer layer, which does not constitute the adhesive layer with the transparent substrate.

Moreover, there is no combination of the cited references which would arrive at the claimed structure including a light-emitting part comprising upper and lower clad layers composed of aluminum gallium indium phosphide joined to a light-permeable substrate via a conductive boron containing Group III-V compound semiconductor layer as required by amended claim 1.

Applicants further comment as follows.

In Udagawa '509 (and also in Udagawa '253), the Group III-V compound semiconductor layer 103 is used as a clad layer formed by crystal growth on the substrate. Consequently, the

layer 103 has a completely different function from that of the adhesive layer 14 in Lin et al, such that there is no suggestion or motivation to replace layer 14 with a cladding layer 103. Because Lin et al discloses in paragraph [0029] that adhesion is conducted using an adhesive agent, Lin et al does not suggest directly adhering the conductive layer with the transparent substrate.

The epitaxial layer 16 disclosed in Lin et al only suggests the use of AlGaAs, AlGaInP, or GaAlP as a material for guarding the p-type AlGaInP clad layer, and Lin et al does not suggest a boron containing Group III-V compound semiconductor layer. Moreover, the epitaxial layer 16 of Lin et al is formed based on the premise of adhering the same by an adhesive agent, and Lin et al does not contemplate directly joining with the substrate. That is, it is not so easy and outside the level of ordinary skill to replace the epitaxial layer 16 with the boron containing Group III-V compound semiconductor layer, and to combine the boron containing Group III-V compound semiconductor layer having a function different from that of the adhesive layer in the transparent substrate.

As to the buffer layer 102/BP-base semiconductor layer disclosed in paragraph [0039] of Udagawa '509, because Udagawa '509 only describes "a boron containing Group III-V compound semiconductor," Udagawa '509 does not suggest the use of "the boron containing Group III-V compound semiconductor" layer for adhering the stacked part with the substrate. Therefore, there is no apparent reason which would lead one of ordinary skill to apply "the boron containing Group III-V compound semiconductor" to the adhering layer to join the substrate.

Further, the function of the boron containing Group III-V semiconductor layer of Udagawa '253 is the same as that of Udagawa '509.

For the above reasons, it is respectfully submitted that the amended claims are patentable over the cited prior art, and withdrawal of the foregoing rejections under 35 U.S.C. § 103(a) is respectfully requested.

Withdrawn method claim 9 has been amended to include all of the limitations of device claim 1. If device claim 1 is found to be allowable, Applicants respectfully request rejoinder of withdrawn method claims 9-11 pursuant to MPEP §821.04.

Withdrawal of all rejections and allowance of claims 1-15 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



Abraham J. Rosner
Registration No. 33,276

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

WASHINGTON OFFICE

23373

CUSTOMER NUMBER

Date: March 10, 2009